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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 296.

Experiment Station Work,

XLI.

Compiled from the Publications of the Agricultural Experiment Stations.

WELLS AND PURE WATER.
PHOSPHATES AND SOIL ACIDITY.
PURE SEED v. POOR SEED.
DISEASE-RESISTANT CLOVER.
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STERILIZATION OF SOILS FOR PREVENTING PLANT DISEASES.
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IMPROVEMENT OF CATTLE.
VENTILATION OF STABLES.
HOG COTS.
PRESERVING EGGS.
AMERICAN CAMEMBERT CHEESE.

MAY, 1907.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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WELLS AND A PURE WATER SUPPLY.[b]

In a discussion of the disposal of dairy and farm sewage in such a way that the water supply may not be injured, O. Erf, of the Kansas Experiment Station, draws some general deductions regarding the construction and care of wells which are of much interest.

It must be borne in mind that the well on a dairy farm and, indeed, on any farm or in any dooryard, can not receive too much care, for it supplies the water for household use, for the dairy farm, for cheese factories, and for other purposes which are related to food supply. Well water is most commonly contaminated in two ways, either by surface water, which runs directly into the well, or by barnyard drainage, household slops, and cesspools.

Sewage disposal may be so managed that it is not a menace to the water supply, one of the most satisfactory methods employing a septic tank, and, as the Kansas experiments show, this need not involve any great trouble or expense.

Discussing well construction, the Kansas bulletin states that—

> Nearly all of the bacterial life exists in the upper strata of the soil. Soil 10 or 12 feet below the surface of the earth is perfectly sterile, unless it has within it a crevice or opening so that surface sewage can run down. Therefore due care should be taken in digging and constructing a well so that direct contamination will be prevented.
>
> The well itself must be so constructed that the impurities can not get into it from above or from the sides. Water should be filtered through 10 or 12 feet of fine soil. To prevent the surface pollution a water-tight wall should be built in a well down below the water level. This can be built of hard, burned brick and cemented on the outside. Clay should be pounded around this.
>
> Where drilled wells are used the lining of the well should be an iron tube driven into the bore and the outside should be flushed with thin cement. The well should be properly covered and the surrounding ground should be considerably higher than the general level of the soil. The walls should extend at least 3 feet above the surface of the ground and a ground fill made so that it will slope from the wall. The top of the fill should be covered with at least 12 inches of clay or loam, upon which it is advisable to have some sod or a layer of sand or, best of all, a pavement sloping in all directions.

If due precautions are taken in the disposal of sewage, care of waste and garbage, and in the proper construction of wells, there is

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[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Kansas Sta. Bul. 143.

little danger of well water becoming polluted. An abundant supply of pure water[a] is a great step toward insuring the health of the household dependent upon the well, and increasing the wholesomeness and healthfulness of the butter, milk, cream, and other products sold from the farm.

AVAILABILITY OF PHOSPHATES IN RELATION TO SOIL ACIDITY.[b]

In an article on this subject in the last report of the Wisconsin Experiment Station A. R. Whitson and C. W. Stoddart call attention to the fact that the fertilizer tests made by the agricultural experiment stations throughout the country have agreed in showing that soil acidity is almost always accompanied by a need of phosphatic fertilizer. They tested the fertilizer requirements of a large number of Wisconsin soils both in the field and in the plant house and the results confirm "the conclusion that acid soils need phosphates, and it will be possible, by a careful test of a soil with litmus paper, to tell if it needs, or will need in the immediate future, a phosphate fertilizer. * * *"

The litmus-paper test can be made in the field, if the soil is moist enough, by inserting a broad bladed knife into the ground and opening a slit wide enough to insert a rather long, narrow strip of litmus paper. With the knife blade the soil is pressed closely against the litmus paper and at the end of about three minutes the paper is carefully removed from the soil. If the paper shows red spots, the soil is acid. If the soil in the field is not moist enough for this test a small portion of it may be placed in a porcelain dish, moistened to the right consistency with distilled water and worked up with a knife blade. By pressing a piece of litmus paper between two portions of the soil with the knife blade and leaving it three minutes, acidity or nonacidity will be shown by the presence or absence of red spots. In every case, whether in the field or in the laboratory, care should be taken that the hands touch the soil as little as possible, because perspiration will turn blue litmus paper red, and lead to erroneous conclusions. The knife blade, the distilled water, and the porcelain dish should be tested to see that they are free from acid. * * *

The reason for this need of phosphates in acid soils may possibly be found in the fact that acids dissolve phosphate minerals, and soil acids, whether due to decomposition of organic matter in the case of peat or to long cultivation in the case of upland soils, will undoubtedly have a decided solvent action on phosphates in the soil, particularly on the calcium phosphates. When once in solution these phosphates are readily washed out by heavy rains. There is undoubtedly considerable phosphate material still remaining in acid soils, but it is at least unavailable to the plant, and it is possible that it may be a phosphate of iron or aluminum, such as dufrenite or wavellite, insoluble in weak acids. * * *

Soils not acid probably contain considerable calcium and magnesium carbonates which, going into solution as the bicarbonates in water charged with carbon dioxid, serve to retain the phosphorus in the form of tricalcium phosphate, relatively insoluble in the soil moisture and yet soluble enough to supply the needs of the growing crop.

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[a] For an earlier paper on pure water see U. S. Dept. Agr., Farmers' Bul. 73, p. 3.
[b] Compiled from Wisconsin Sta. Rpt. 1906, p. 171.

PURE SEED VERSUS POOR SEED.[a]

The Kansas Station recently published a special circular comparing the cost of obtaining a full stand of alfalfa when pure and poor seed are used. Attention is called to the fact that in 1905 Kansas had an area of 1,018,206 acres devoted to cultivated forage crops, of which 602,560 acres was in alfalfa. The cost of seeding this alfalfa acreage at the rate of 15 pounds per acre with seed at 16 cents per pound, every single seed being good, would amount to $1,446,128, but taking as a basis from among the number of alfalfa seed samples analyzed by the station 28 showing an average of total impurities of 46.1 per cent and an average number of seed true to name but incapable of germinating of 34.5 per cent, it would have cost $1,935,042 to secure a full stand on the same area.

Letters from all portions of the State indicate that poor alfalfa seed is quite common. The principal impurities are dead and defective alfalfa seed itself, trefoil, English plantain or buckhorn, dodder, Russian thistle, crab grass, foxtail, and other weed seeds, and the adulterants often found are trefoil, bur clover, and sweet clover. It is pointed out that with good standard alfalfa seed, averaging 83 per cent of the seed true to name and capable of germinating, the cost of seeding an acre would be $2.40. This represents the actual cost of the 83 per cent of good seed, the 17 per cent being waste, and the real cost per bushel of viable seed is therefore about $12 instead of $10, at which the seed and the waste together was originally bought. In a certain sample of seed analyzed by the station only 20.2 per cent of the seeds were true to name and capable of germinating. A computation based on the cost of the standard seed shows that in order to obtain from the use of this poor seed as much of a stand as could have been secured with 15 pounds of the standard seed 73.9 pounds of this seed would have been necessary, and the actual cost of seeding an acre would have been brought up to $11.92, and the actual cost of the seed exclusive of the 79.8 per cent of waste to $49.26 per bushel. In addition to this prohibitive cost, the use of seed like this sample would have deposited on each acre over 4,000,000 weed seeds of various species, or 105 on each square foot. The use of seed represented by another sample studied would have raised the cost to $5.75 per acre, and would have sown this area with approximately 167,000 weeds of various sorts, including 95,000 plantain seed, 19,000 dodder seed, and 25,000 foxtail seed. Bad seed gives a weak, poor stand of alfalfa and a dense growth of weeds and wild grasses. In the 28 samples referred to above the impurities ranged from 21.6 to 100 per cent, the trash or dirt from

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[a] Compiled from Kansas Sta. Spec. Circ., January 30, 1907.

0.3 to 31.9 per cent, and the number of kinds of foreign seed present from 3 to 34.

These investigations with reference to bluegrass seed within the State show that Kentucky bluegrass seed is extensively adulterated with Canadian bluegrass seed, from which it is not distinguishable by the ordinary observer, especially when mixed with it. English bluegrass is very commonly adulterated with cheat, the seeds of the two plants resembling each other sufficiently to make adulteration easily possible. The quality of English bluegrass seed is frequently very poor, the germination in many cases not being above 40 per cent. A certain lot of this seed bought and sold in the fall of 1905 contained less than 50 per cent of germinable seeds, and the percentage of weed seeds was so high that on each acre there were sown with the English bluegrass seed 142,230 seeds of crab grass, 111,000 seeds of dock, 393,670 smartweed seeds, 62,340 cheat seeds, together with 111,000 miscellaneous seeds, making a grand total of 820,240 weed seeds of all kinds. The crop harvested contained only about 15 per cent of English bluegrass seed, while 79 per cent was cheat and the rest seeds of such weeds as bindweed, dock, foxtail, and pigweed.

The brome grass seed marketed in the State is also adulterated with cheat, and much of it has a percentage of germination of only about 40. A comparison of the different grades of seed as estimated and determined by the station is given in the following table:

The cost per acre of standard and poor seeds compared.

Samples.	Good seeds.	Seed required per acre.	Cost of seeding an acre.	Germinable seed, cost per bushel.	Weed seeds per acre.	Weeds per square foot.
	Per cent.	*Pounds.*				
Alfalfa 201	52.0	28.7	$4.63	$19.21	93,910	2
Alfalfa 20	73.6	20.3	3.07	13.58	238,750	5
Alfalfa 215	66.3	22.5	3.63	15.00	313,730	7
Alfalfa 227	42.0	35.7	5.75	23.80	167,470	3
Alfalfa 267	20.3	73.9	11.92	49.26	4,241,950	105
Alfalfa standard	83.3	15.0	2.42	12.00		
English bluegrass 284	49.3	105.4	1.05	4.05	820,240	
English bluegrass 375	43.4	120.0	12.00	4.80	36,000	
English bluegrass standard	80.7	50.0	5.00	2.47		
Brome grass 107	49.5	50.0	3.85	3.00	157,000	
Brome grass 229	32.4	77.0	8.25	4.65	207,900	
Brome grass standard	67.5	25.0	2.68	2.38		

It is believed that seed market conditions will not be improved without legislation, and it is pointed out that a law excluding from sale any seed with a percentage of germination below 76 would make a saving of at least 10 per cent each year, or of a total amount of nearly $22,000 on forage crops alone. A seed law proposed for the State requires a guaranty of 85 per cent of germination and imposes a tax of one-fifth of a cent on all seed packets less than 1 pound and of one-fifth of a cent per pound for all seed in bulk, and it is estimated

that the operation of this law would save the State of Kansas 14 per cent net annually in cost of alfalfa seed and 25 per cent net in all other forage crops over and above the tax.

SELECTION FOR DISEASE-RESISTANT CLOVER.[a]

For a number of years the culture of red clover in Tennessee has been uncertain on account of a fungus disease which attacks the crop. In some parts of the State this disease has become so severe that clover growing has been practically abandoned. The disease has also appeared in Virginia, West Virginia, Kentucky, and Arkansas, and is found to occur on alfalfa as well as on red clover.

In 1905 Professors Bain and Essary, of the Tennessee Station, began to investigate this problem and found the trouble to be due to an undescribed fungus disease, a form of anthracnose. The fungus causing the disease belongs to the genus Colletotrichum, and was named *Colletotrichum trifolii*. The trouble occurs in new as well as in old fields of clover, but is usually the more severe where clover has been grown for some time. In many instances this disease almost entirely kills out a good stand in one season. As spraying methods, disinfection of seed, and methods of cultivation promised little toward finding a remedy, all efforts were concentrated on the production of a disease-resistant strain of clover by selection, and the results of the first year's work, which seemed very encouraging, are presented in a recent bulletin of the station.

During August and September of 1905, at which time most of the disease-infected clover had died, over 200 isolated healthy plants, having withstood the attack of the disease on badly infected fields, were selected and the seed of each individual plant kept separate. The seed was planted in rows 18 inches apart, and the select rows were alternated with ordinary commercial clover seed. On the land used for the purpose the disease had totally destroyed the clover crop in 1905, and in order that it might again prevail in 1906 the ground was only thoroughly disked, as it was thought that plowing would cover the germs too deeply. After the clover had been up five weeks a load of dead clover raked up from a field destroyed by the fungus was scattered over the plat, putting practically every plant in direct contact with this infected material. On July 15 the dead and diseased plants from the nonselect rows were scattered over the selections as a further source of infection. Insect ravages reduced the number of plants to a considerable extent, but enough were saved to continue the experiment. Careful cultivation induced vigorous growth until June 1, when the plants from the commercial seed showed signs of the disease. By June 20 the unselected rows were blackened and dying, while the select rows alternating with them were almost perfectly

[a] Compiled from Tennessee Sta. Bul. 75.

healthy and normal. The entire plat had been mowed off between July 9 and September 14, in order to simulate actual cultural conditions.

It was estimated that of the select plants 95 per cent lived up to the end of this period, while of the nonselect plants not more than 5 per cent survived. While the selections nearly all made a fair average growth, many showed lesions of the disease by September 14, but a good crop of stems, leaves, and seed was obtained, and a satisfactory number of plants were exceptionally vigorous and without a trace of the anthracnose. A number of plants of both select and nonselect parentage died during the winter, but on the whole the selections were decidedly the more healthy in appearance. Basing the estimate on the percentage of surviving plants of each group to the approximate number of that group which germinated, the odds in favor of the selections appeared as 50 to 1.

The authors have found this disease on alsike clover in only one case, a seedling growing in the greenhouse. To study the life history of the fungus a number of flowerpots were seeded July 12 with red clover, alsike clover, and alfalfa. On July 22 these plants, after having made a vigorous growth for some days, became accidentally infected. The red clover and alfalfa seedlings succumbed rapidly to the disease, but the alsike clover seedlings proved immune. A few surviving plants of red clover and alfalfa were probably resistant to the disease.

The most important result of the above-described experiments is the striking indication of disease resistance shown by select individual red clover plants. Since every opportunity existed for the infection of the plants from select seed, and they were subjected to the most rigid test for susceptibility to disease, there is very strong indication, at least, that success will attend the effort being made to produce an anthracnose-resistant clover. The evidence may be briefly stated thus: Certain clover plants growing in 1905, surrounded by great numbers of other plants killed by anthracnose, produced offspring which, in turn, also resisted the disease alongside nonselect plants which were killed by the disease. Of course it remains to be seen whether the next and subsequent generations will likewise resist the disease.

ERADICATION OF WILD MUSTARD.[a]

Wild mustard is a well known and very widely distributed weed pest and one which it is very difficult to eradicate when once introduced. R. A. Moore and A. L. Stone, of the Wisconsin Experiment Station, have, however, been quite successful recently in destroying the weed in grain fields by spraying with a solution of iron sulphate.

The solution is made by emptying a hundred pound sack of iron sulphate into an ordinary 52-gallon cask (kerosene or vinegar barrels are gauged for approximately that amount) and then stirring until the sulphate goes into solution. Iron sulphate is in a granular form similar to that of salt or sugar and goes into solution readily. When stirred vigorously seven to ten minutes the sulphate is dissolved. Made in the proportions given, we found that the mixture was practically a 20 per cent solution, the

[a] Compiled from Wisconsin Sta. Rpt. 1906, p. 259.

proper strength, although some German experimenters have bad good results by using a 15 per eent solution.

The solution was sprayed on an oat field badly infested with the weed when the plants were in the third or fourth leaf. The results show that in all cases practically all of the weeds were destroyed.

The spraying should be done on a calm, bright day, after the dew has disappeared, as the work is more effective if tbe solution is put on in the warm sunlight. When rain follows tbe spraying within a few hours the extermination of the mustard will not be complete.

The grain fields should be sprayed when the mustard plants are in the third leaf, or before tbe plants are in blossom, in order to have the spray do the most effective work. The day following tbe spraying the tips of the blades of grain may be somewhat blackened, but no detrimental effeets can be noticed, eitber to the crop or grasses seeded with it, two weeks after spraying.

Daisies, cocklebur, bindweed, ragweed, chicory, sheep sorrel, yellow dock, wild lettuee, and many otber weeds were partially or wholly eradicated from the fields where tests were made for the extermination of mustard.

Iron sulphate can be purehased for about $11 per ton in small quantities and in bulk for considerably less. One hundred pounds of iron sulphate will make suffieient solution of the proper strengtb to spray approximately 1 aere. From 20 to 25 aeres of land can be covered in a day where the sprayer is kept in continual use.

Tbe iron sulphate solution is not poisonous and can be readily handled without injury. White elotbing coming in contact with it will be discoiored, but not burned.

STERILIZATION OF SOILS FOR THE PREVENTION OF DISEASES OF PLANTS.[a]

Growers of lettuce, cucumbers, tomatoes, carnations, violets, and other plants under glass and of plants in seed beds often find the plants suddenly dying while their foliage seems to be fresh and vigorous. This is especially true of plants in their seedling stage, and a careful examination will show that they are affected at or below the surface of the soil. The causes of the trouble are certain soil fungi and minute worms, called eelworms or nematodes. Where it is possible to renew the soil in the beds every season comparatively little loss will be met with, provided the soil is not infested when put in the beds. When the same soil is used season after season it is likely to become so filled with fungi and nematodes that the production of healthy, stocky plants will be impossible. The fungi, which are usually sterile, are present as minute threads or mycelia and the nematodes as active worms or as eggs and encysted or dormant forms. The fungi enter the plant through the roots and cause various forms of drop, wilt, and rot, while the nematodes cause galls on the roots and thus interfere with their function as absorbers and conveyors of water and mineral matter to the plant.

[a] Compiled from Connecticut State Sta. Rpt. 1897, p. 310; Massachusetts Sta. Bul. 55; Rpts. 1898, p. 149; 1899, p. 59; 1901, p. 74; 1902, p. 38; 1904, p. 10; Ohio Sta. Bul. 73, Circs. 57 and 59. For previous articles on this subject see U. S. Dept. Agr., Farmers' Buls. 186, p. 8, and 259, p. 9.

Drying and freezing have comparatively little effect upon these parasites and spraying the foliage with fungicides will be of no value, since it does not reach the seat of the trouble. Fortunately it is possible to almost wholly prevent the injury due to these parasites by the sterilization of the soil, either by heat or by chemical treatment. The old practice of burning brush and other material over the site of the tobacco seed beds unconsciously secured sterilization, although by many the benefit was attributed to the presence of the ashes. Heating the soil in any way, provided it is thoroughly done, will destroy fungi and nematodes. Dry heating and burning are not always convenient or advisable, but sterilization by the application of steam is entirely practicable. This can be done in boxes especially designed for the purpose or may be effected by leading perforated steam pipes through the beds.

The box method is fully described by G. E. Stone, of the Massachusetts Station, and W. E. Britton, of the Connecticut State Station, and consists essentially of tight zinc-lined boxes into which steam can be admitted under pressure, and the soil is held in shallow trays with galvanized-iron netting bottoms. Space is allowed between and around the trays, and an exposure of one hour to steam will destroy all nematodes and most fungi and their spores as well as any weed seed that may be in the soil. After exposure to the steam the soil can be spread in the beds and seeded as soon as convenient.

Doctor Stone and others have shown that as a rule seed germinates more quickly and plants develop better in sterilized than in unsterilized soil. The reason for this was studied by Schulze[a], a German investigator, who found that while during sterilization there were formed some decomposition products which are injurious to a certain extent for a time, these disappear after the lapse of a few days or are corrected by the addition of a small quantity of lime, and there was always an increase in the amount of available nitrogen present in sterilized soil due to the action of heat on the soil compounds, so that while the growth in sterilized soil may be retarded for a short time the plants ultimately become more vigorous and the total growth is decidedly greater in sterilized soils.

Where benches are prepared with tile for subirrigation the steam can be led into the tile and the expense of sterilization will be nominal. Where the soil is treated with steam passed through perforated iron pipes the cost of sterilization has been estimated at about $8 per 1,000 cubic feet of soil. By better apparatus the cost could be reduced to about $2 per 1,000 cubic feet.

Where steam is not available it has been found that certain chemicals injected into the soil will aid in sterilizing it. A. D. Selby, of

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[a] Landw. Vers. Stat., 65 (1906), No. 1-2, pp. 137-147.

the Ohio Station, has found that formalin or formaldehyde applied to the soil in a strength of 2 pints of formalin to 50 gallons of water is quite efficient for the destruction of fungi and active nematodes, although it does not destroy the nematode eggs or encysted forms. For these steaming is best. To treat soil with formalin it should be prepared as for seeding, and after being well raked and in a friable condition it is drenched with the solution as given above at the rate of about 1 gallon per square foot of surface. A bed 50 feet long by 6 feet wide would require about 300 gallons of the mixture containing from 12 to 15 pints of formalin. This would cost from $1.80 to $2.25 in carboy lots. If applied to seed beds in the fall before freezing weather sets in this treatment will keep down all forms of rot, damping off, and similar plant diseases.

PRODUCTION OF SEEDLESS TOMATOES.[a]

The production of any vegetable novelty always arouses interest among seed growers and gardeners. More or less of this work has been done by the experiment stations. For a number of years breeding experiments with vegetables have been carried on by Professor Halsted and his associates at the New Jersey stations. Among the distinct and valuable productions secured in this work is a nearly seedless tomato. As is well known, each fruit of the ordinary tomato contains hundreds of seeds, while the form which Professor Halsted has developed seldom contains more than fifty seeds and frequently there are not more than five or six and often none.

This variety has become pretty well established now and has been called the Giant because of the very large size that the plant attains. It originated five or six years ago as a result of a cross of Golden Sunrise upon Dwarf Champion.

> The seedlings frequently bear three cotyledons, and the plants are very slow, growing long stemmed, with the foliage open, due to the long internodes, and leaves with the divisions widely separated, which are crinkled, and the terminal leaflet blunt pointed. The flower clusters are small, flowers cup shaped, light lemon yellow, and the fruits few, medium small, light yellow, and nearly seedless. The flesh is particularly fine flavored. The plants, 3 feet apart each way, covered the ground devoted to the block, and flowered up to the killing frosts near November 1.

The type appears to be well fixed. Attempts to cross other sorts upon it have uniformly failed.

Seedless fruits have also been produced by Professor Halsted on several varieties and crosses of tomatoes, due probably primarily to nonpollination with other conditions favorable to the stimulation of fruit production. These crosses were quite uniformly dwarfed in size, many in a cluster being not larger than peas, but solid fleshed, and

[a] Compiled from New Jersey Stas. Rpts. 1901, p. 442; 1903, p. 492; 1904, p. 491; 1905, p. 468; Wisconsin Sta. Rpt., 1905, p. 300.

often of good quality. In one instance the fruit had the flavor of the strawberry. Currant crossed upon Stone produced such fruit, likewise Crimson Cushion upon Sumatra. When Crimson Cushion was crossed upon Giant and Magnus many seedless fruits were produced, some of which were large enough for table use. Cuttings taken from plants which produced numerous seedless fruits of this sort when planted out in the garden gave only normal fruits.

E. P. Sandsten, working at the Wisconsin Station, produced seedless tomatoes by an entirely different method, i. e., the use of excessive amounts of fertilizers. He worked in the greenhouse with a good potting soil, using commercial fertilizers at the rate of 800 pounds of nitrate of soda, 600 pounds of sulphate of potash, and 1,000 pounds of desiccated bone per acre. Many abnormalities in the growth of the plants and fruit were observed. "In almost all cases there was a tendency of the plants to produce fruits containing a much smaller number of seeds than is generally found in the ordinary fruit." In one instance the plant was dwarfed and the fruit not larger than a walnut, but firm fleshed and entirely seedless. Another plant produced a large solid fruit that was seedless. Cuttings taken from these plants and set outdoors remained true to type, but produced more and larger fruit than in the greenhouse.

We thus have at least two ways of securing seedlessness in tomatoes—by crossing and selection and by high feeding with fertilizers. The work with seedless tomatoes at both these stations is being continued and promises to result in the establishment of varieties with far less seeds in than the sorts commonly grown. It brings out strikingly the variations that may occur in plants as a result of crossing and high feeding with fertilizers.

PICKLING OLIVES AND MOCK OLIVES FOR HOME USE.[a]

In California, Arizona, and other States where olives can be grown successfully many housewives are interested in pickling them by household methods for home use. According to experiments carried on at the Arizona Station by W. W. Skinner this can be successfully done.

The two varieties which have given the best results in home pickling are the Mission and Manzanillo. "The Mission holds its color well while being pickled, and with reasonable care in the extracting process yields a product which is firm and of good flavor. The Manzanillo is superior to the Mission in flavor, but the fruit is of a finer texture and is prone to soften during treatment; nor is the color of the finished product so good as the Mission."

[a] Compiled from Arizona Sta. Bul. 51, California Cir. 24, Wisconsin Sta. Bul. 136. See also U. S. Dept. Agr., Farmers' Bul. 122, p. 16.

The olives, either green or ripe, should be picked into pails about one-third full of water, to prevent bruising, and sorted as to size and ripeness. The fruit is then placed in suitable vessels (preferably stone jars, though wooden kegs, etc., may be used if sterilized so that they are free from mold spores), the water poured off, and the fruit covered with a solution made of 2 ounces of soda lye, 1 ounce of lime, and 1 ounce of common salt to a gallon of water. The solution should be thoroughly mixed and allowed to stand an hour before using, and is best if made of boiled and cooled water. It should stand about 2 inches above the fruit, and if any of the olives float it is necessary to cover them with a board and weight.

The time of the lye treatment varies from three to seven days, according to the variety, size, and ripeness of the fruit. The solution should be examined daily, and should the sleek, soapy feeling peculiar to lye disappear, it indicates that the solution is exhausted. The old solution should therefore be poured off and new solution added. It should also be changed at once should any scum or mold appear. The fruit should be frequently examined, always sampling the largest olives by cutting away a portion with a sharp knife. The progress of the lye toward the interior of the fruit is plainly marked by a distinct dark ring. When the ring has reached almost but not quite to the pit, it is time to remove the lye and commence the washing.

The lye should now be poured off and water added and renewed morning and night. The wash water should also be boiled as a preventive of mold, which is very likely to develop at this stage of the pickling process. The fruit should be kept in water, as before, with the board and weight, and throughout the extraction, washing, and salting the vessel should be closely covered. It will require from four to seven days to remove all traces of the alkali. Washing should be continued as long as the fruit has the peculiar hot taste due to the presence of lye, and it is well to test it with red litmus paper, which will turn blue if a trace of the lye remains. If the olives are still bitter after the washing has been completed, they should receive a second treatment with lye, followed by washing.

When free from lye the olives are ready for salting, the brine being composed of 2 ounces of common salt to a gallon of water. It should be thoroughly boiled, cooled, and poured over the olives. The next day this solution should be poured off and a solution containing 4 ounces of salt should be used. "If the stronger solution is used to begin with, the olives will shrivel. The fruit should next be treated with an 8-ounce brine, and if intended to keep for some time, finally with a brine containing 14 ounces of salt to the gallon. A 14-ounce brine, however, makes the olives too salty to be used without a slight soaking."

In the author's opinion, a better method of keeping the finished product is to process the olives after adding the 8-ounce brine. Glass fruit jars filled with olives and brine, with the covers lightly screwed

down over the rubbers, are stood in water in a tin wash boiler and heated to 175° F. for thirty minutes. They should be then removed and the covers quickly tightened. "By this process the flavor of the olive is not injured, and if properly done the fruit will keep at least several months without deteriorating."

Mrs. L. H. Adams and E. P. Sandsten, of the Wisconsin Experiment Station, in a recent bulletin state that mock olives can be made for home use from unripe plums. According to the directions which they give, the plums when just beginning to ripen, but still green, should be pickled in a brine strong enough to hold up an egg; the brine may be made from sea salt, or, if this is not convenient, from common rock salt. The brine should be poured, hot, over the fruit and allowed to stand for twenty-four hours. It should then be poured off and the fruit placed in a new brine, boiled for one minute, and sealed in the hot brine in suitable jars.

THE HAY BOX OR FIRELESS COOKER.[a]

Considerable interest has been manifested recently in a system of cookery in practice in Norway and other parts of Europe, in which boiling hot food in tightly covered receptacles is packed in some nonconducting material in such a way that it keeps hot for a long time and slowly cooks. As hay is commonly used in Europe as a packing, the cooker is frequently called a "hay box cooker." Sometimes it is spoken of as a "Norwegian nest," and the name "fireless cooker" is also used. The principle involved is a simple one, namely, the retention of heat and hence the continuation of cooking by surrounding hot food with some nonconducting material.

Just when the Norwegian cooking apparatus was devised it would be hard to say, but it has been in use for a long time and in 1867 excited considerable interest and curiosity when it was shown as a part of the Scandinavian exhibit at the Paris Exposition. W. Mattieu Williams[b] describes it in his treatise on cooking, first published a number of years ago, as being well known, and also makes reference to an experiment of Count Rumford's in which meat was cooked under similar conditions—that is, by keeping it for a long time at a temperature somewhat lower than that of boiling water. Many persons are doubtless familiar with Williams's own experiments in which eggs were cooked in a fireless cooker. The eggs were placed in an earthen vessel filled with hot water, which was then tightly covered, wrapped in flannel, packed in a padded hat box, and allowed to remain overnight. In the morning they were found, he says, to be "cooked to perfection."

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[a] Compiled from Cornell Reading Course for Farmers' Wives, 5. ser., 1907, No. 23, p. 446; Rept. Commis. Gen. [U. S. Army], 1905, p. 80; 1906, p. 14.

[b] Chemistry of Cookery, 1885, pp. 23, 29, 30.

According to Williams's description, the Norwegian cooking apparatus "consists of an inner tin pot with well-fitting lid, which fits into a box, having a thick lining of ill-conducting material—such as felt, wool, or sawdust (it should be 2 or 3 inches thick, bottom and sides). A fowl, for example, is put into the tin, which is then filled up with boiling water and covered with a close-fitting cover lined like the box, and firmly strapped down. This may be left for ten or twelve hours, when the fowl will be found most delicately cooked."

From time to time articles have appeared regarding this method of preparing food, and recently considerable interest has been manifested in the subject, perhaps owing to the efforts of the German Government[a] to direct the attention of the families of small means to this device as furnishing an economical method of cookery. The popular descriptions[b] of this sort of cooker, which have appeared now and then, differ more or less in details, but the principle is always the same, namely, the retention of heat by surrounding the food with nonconducting material.

Such cookers may be readily made at home, and even when they are of very simple construction they have given good results provided they are well packed with insulating material. A tightly covered tin or enameled can or bucket or a kettle preferably without a handle, but having a tight cover, and a wooden box and packing material are the essential features. The packing box or other receptacle should be considerably larger, say 3 or 4 inches in every direction, than the vessel used for cooking. Line the box with several thicknesses of paper or with asbestos. Over the bottom of the box should be spread a thick layer of hay, crumpled newspaper, or similar material tightly packed. The cooking vessel is placed on the center of this and the spaces between it and the sides of the box packed full of the hay or whatever is used. A thick cushion or pad of suitable size should be made for covering the top of the can and a wooden cover for the box is also desirable. In some of the cookers which have been described in magazines, etc., thick felt, asbestos, cork, and other nonconducting materials have been used for packing, but good results have been reported with the simpler materials.

These cookers may be made to hold one or more cooking vessels, and in case space is desired for two or more it is convenient to divide the box into compartments.

Figure 1, which is drawn from data furnished by tests carried on at the Cornell Agricultural College and Experiment Station, in connection with home economics courses, shows a cooker suitable for two cans.

[a] Mo. Consular and Trade Rpts. [U. S.], 1905, Nos. 297, p. 15; 302, p. 242.

[b] Home Sci. Mag., 20 (1903), p. 9; Amer. Agr., 79 (1907), No. 1, p. 27; Everyday Housekeeping, 22 (1906), p. 816; The Hay-Box Cook Book, Chicago, 1906.

The tests at Cornell have been satisfactory and the hay box cooker "is recommended to housewives as a means of saving fuel and securing good results in cooking cereals, chicken, macaroni, or anything requiring long, slow cooking or steaming."

The food which is to be cooked is brought to the boiling point in the can or bucket and cooked for a short time, two or three to twenty minutes usually, or perhaps ten minutes on an average (though the time depends upon the material and should be learned by experience), and is tightly covered and placed in the nest and covered on top with the cushion and the lid of the box closed. The cool air of the room can not pass through the packing to the can nor can the heat inside it pass through the nonconducting material, except very slowly, and so the food remains hot for several hours and cooks thoroughly and evenly without further attention. According to the Cornell report, "about twice as much time is required as in cooking over the flame. There is little evaporation. Consequently, care must be taken not to use too much water in preparation. Many articles of food are better for long, slow cooking, and as neither fire nor attention is needed (after the initial heating) it proves an economical means of preparing food for the table." An advantage claimed for the hay box cooker is that there are no noticeable odors from the cooking food.

FIG. 1.—Hay box or fireless cooker.

The cooker must not be opened from the time the food is placed in it until it is needed for serving, as the removal of the covering, etc., would mean an escape of heat.

Cookers constructed on the principle outlined have been tested

for several years by the Commissary Department of the United States Army and have given good satisfaction, particularly for the preparation of rations for soldiers on the march. According to the reports of the Commissary-General, the cookers used are of large size and special attention is given to packing materials and other factors so as to insure the insulation of the containers in which the food is cooked. The meat, beans, cereal, or other food is heated in the can at breakfast time, packed, and carried in carts with the other camp equipment while the men are on the march, and when camp is reached at night a hot soup or other dish is ready without the delay attendant on cooking a hot meal in the usual way.

In this system of cookery the food is kept on the stove for only a short time, and hence only a small amount of fuel is required, and it has a further advantage in that it does not heat the rooms in which the cooking is done.

By means of this cooker a breakfast cereal may be prepared by boiling it a few minutes in the evening, then packing it away in the cooker, and in the morning it will be ready for use. Soup can be prepared early in the day and will be ready for luncheon without any further attention. In the descriptions of the hay box cited above and other similar publications the writers, on the basis of personal experience, give directions for the preparation of vegetables, meats, soups, desserts, and other dishes, and the consensus of opinion seems to be that the hay box cooker is a convenient. economical, and labor-saving device.

COMBATING INSECT ENEMIES OF SHADE TREES.[a]

In recent years more and more attention has been given by municipal authorities to the condition of shade trees within the city limits. A number of insect pests of prime importance have attacked trees used for shade purposes in cities, and where no attention has been given to these pests they have often completely defoliated even the largest shade trees along the streets and in city parks.

At first it was considered difficult, if not impossible, to apply direct insecticide treatment to tall elms and other shade trees. Prof. J. B. Smith, of the New Jersey Station, however, showed that if a strong barrel pump were used and a bamboo extension pole attached to the hose for holding the nozzle as far as possible from the ground, trees of moderate size could be readily sprayed with insecticides. Since that time various power sprayers have been put in operation by means of which sprays may be thrown to the top of the tallest shade

[a] Compiled from Illinois Sta. Bul. 112; Kentucky Sta. Bul. 120; Massachusetts Sta. Bul. 114; New Hampshire Sta. Bul. 128; New York Cornell Sta. Bul. 233; U. S. Dept. Agr., Farmers' Bul. 99.

trees. Since the most serious shade-tree insects feed upon the foliage and may, therefore, be destroyed by the use of arsenicals, it becomes merely a matter of civic pride whether suitable means will be put in operation for protecting shade trees. It has been estimated by Doctor Howard that with an expense of $4,000 or $5,000 annually almost any city in the United States may keep the foliage of its shade trees in a green condition throughout the growing season.

Great differences have been noted in the susceptibility of various species of shade trees to insect attacks. The least susceptible is the ginkgo, which in this country has not been attacked by any serious insect pest. The tulip tree is almost equally free from insects, although plant lice and gall midges may disfigure the leaves to some extent. It is not practicable, however, to plant in all cities only those trees which are free from insect pests. Strong preferences are held by the citizens of different municipalities for elms, maples, lindens, and other well-known shade trees which are more or less seriously attacked by insects. In order to protect their foliage from destruction during the growing season it is necessary, according to the experience already had in various cities, to place the work of insect control on shade trees in the hands of a city forester or superintendent of parks.

Among the most serious insect enemies of shade trees are the elm leaf-beetle, tussock moth, bagworm, fall webworm, brown-tail moth, gipsy moth, cottonwood leaf-beetle, and cottony maple scale. Recently the oriental moth has been discovered in Boston and threatens injury to shade trees. All of these insects except the cottony maple scale may be destroyed by spraying the foliage with arsenicals, especially arsenate of lead. The first application may be made immediately after the buds have opened and further treatment may be regulated according to the abundance of leaf-eating insects in any given locality. Most of the pests mentioned in the list of important shade-tree insects are open to other methods of attack. Thus, the winter nests of the brown-tail moth should be destroyed before the insects become scattered in the spring. The gipsy moth may be captured by banding the trees and its numbers will be greatly reduced by destroying the egg masses. The elm leaf-beetle in the larval condition may be destroyed about the base of the trees by spraying with kerosene emulsion. The egg clusters of the tussock moth are conspicuous and may be easily removed and destroyed.

Serious outbreaks of cottony maple scale have been reported during the last two or three years in Chicago and other cities. This pest must be controlled with contact insecticides, among which kerosene emulsion has given the best results. The cottony maple scale attacks chiefly the soft maple, linden, box elder, elm, and honey

locust. In a series of experiments carried out by Professor Forbes, of the Illinois Experiment Station, it was found that the most useful insecticide for the control of this pest was kerosene emulsion, which, if applied in summer, should not contain more than 10 to 12 per cent of kerosene, and if used in winter not more than 16 to 18 per cent. It is recommended that the first summer application be made when about half of the eggs are hatched and the second just at the end of the hatching period. As a rule, however, a thorough winter application of the stronger kerosene emulsion is more effective than the summer treatment.

FEEDING WHOLE GRAIN.[a]

In ordinary digestion experiments with farm animals the proportions of nutritive materials remaining in the feces are determined by chemical analysis, and such data are of course admirably adapted for the study of many problems.

A mechanical method of separating the undigested from the digested material is sometimes followed in the study of various practical questions connected with animal feeding. It is customary in such tests to mix the manure with large quantities of water, which washes away the metabolic products and similar materials and leaves the undigested grain behind. The fact that the manure may contain considerable undigested material receives practical recognition in animal feeding. Pigs are very commonly allowed to follow fattening steers in order that they may gather and utilize this food which would otherwise be wasted.

In tests undertaken at the Kansas Station to determine the relative amounts of soaked and dry corn thus available for pig feeding, the droppings from two lots of steers were gathered for twenty-eight days. The undigested corn was carefully washed out from the feces and weighed and it was found that the steers fed the soaked corn failed to digest 11 per cent of the 3,045 pounds eaten and those fed the dry corn 16 per cent of the 3,060 pounds eaten. The grains compared in a later test at the Kansas Station, which covered thirty-three days, included corn meal, red Kafir corn meal, and white Kafir corn meal. Washing away the digested material from the undigested showed that 5.5 per cent of the corn meal, 11.3 per cent of the red Kafir corn meal, and 14.1 per cent of the white Kafir corn meal passed through the animals undigested. The utilization of the undigested material by pigs was one of the principal features studied in both of these tests.

A recently published bulletin of the Michigan Station reports the results of a study undertaken to determine the proportion of whole corn, whole oats, and a mixture of these grains which escaped diges-

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[a] Compiled from Kansas Sta. Buls. 47 and 67; Michigan Sta. Bul. 242.

tion when fed to cattle. According to R. S. Shaw and H. W. Norton, jr., who carried on this work—

For some time past the system of feeding whole grain has had many advocates. Some speakers and writers on agricultural and live-stock subjects have advised the use of whole corn either alone or in conjunction with other grains for steer feeding, and many farmers are feeding whole oats to cows, young stock, and calves.

The presence of large quantities of oats in the droppings from cows fed a grain mixture containing whole oats, and the fact that a field manured with these droppings produced a fairly good stand of oats suggested an experiment to determine the percentage of whole grain passing through the digestive tract. * * *

Claims are also made by advocates of this method of feeding that even though a large amount does pass through without apparent change still the animal "gets a lot of good out of it." To clear up this last question chemical analyses were made to find the exact composition of the grain both before and after feeding in order to detect any changes taking place. * * *

No attempt was made to compare the feeding value of whole grain with ground grain, nor was any attempt made to ascertain the gains or losses in weight made by the animals while on the whole-grain feed.

Each of the grain rations was tested with lots containing two cows, two heifers, and two calves, the feeding period covering seven days.

All grain fed was weighed and all droppings collected and washed through screens to separate the grain. The screens were as fine meshed as could be used and still allow the escape of everything but the grain; in fact some of the oats were washed through and lost. * * * The grain was then spread out in a warm room and dried and run through a fanning mill to clear from straw and chaff and was finally weighed. Samples were taken for chemical analyses.

The following table shows the proportion of the grain eaten which was recovered whole in the feces:

Proportion of grain eaten recovered whole in the feces; experiments with cattle.

Kind of animal.	Whole corn recovered.	Whole oats recovered.	Whole corn and oats recovered.
	Per cent.	*Per cent.*	*Per cent.*
Cows	22.75	12.06	26.46
Heifers	10.77	5.48	17.50
Calves	6.28	2.98	5.78

It will be noted that in every case smaller quantities of undigested grain were found in the droppings of the younger animals and that the proportion of corn which escaped digestion was greater than that of oats.

Chemical analyses showed practically the same composition of grain as before feeding; therefore it is safe to conclude that the animal derives no benefit from grain which passes through the digestive tract unmasticated.

The germinating power of the grain passing through the system was affected very markedly but not entirely destroyed, as 4.3 per cent of the corn and 10.6 per cent of the oats germinated after this treatment.

The data reported are not sufficient for general deductions as to the relative merits of whole and ground grain or soaked and dry

grain, but they do clearly show that in ordinary methods of feeding the proportion of grain which escapes digestion may be considerable. It is a matter of experience that cattle fed large grain rations toward the close of a fattening period digest such feed less completely than animals eating smaller quantities. Factors like the above should receive consideration in regulating the number of pigs following fattening steers and other questions connected with animal feeding, in order that the greatest profits may be secured.

The length of time which grain remains in the digestive tract was one of the questions considered in the tests at the Kansas Station. On one day of a feeding period red Kafir corn was substituted for the white Kafir corn which made up the grain portion of the ration. On the day immediately following it was found that red kernels began to appear in the manure and the maximum number was noted on the afternoon of the second day. They then began to decrease, and on the fourth day only a few red kernels were found in the washings.

THE IMPROVEMENT OF CATTLE.[a]

The Michigan Experiment Station has begun animal-breeding experiments, and a recently published general discussion of breeding problems by R. S. Shaw is the outcome of this work. In Professor Shaw's opinion very many Michigan cattle breeders raise inferior milch cows and steers, the chief fault of the common cattle being a lack of quality and uniformity, which is due not so much to lack of the infusion of good blood as to the indiscriminate admixture of beef and dairy types.

> With the rise in prices of dairy products, the common cows have been bred to dairy bulls; with depreciated values for dairy products, these same cows and their female progeny have been bred back to beef sires, and so on. On the other hand, there are plenty of instances where herds possessed of cows of a small type, producing a small flow of rich milk, have been bred to a bull of a larger breed noted for heavy milk flow, and vice versa.

In urging that widespread attention be paid by Michigan cattle raisers to improvements in dairy and beef herds, a number of general deductions are drawn regarding some of the more important phases of cattle breeding. In the author's opinion live stock improvement is not difficult.

> Questions of breeding are generally regarded as being obscure, intricate, and extremely difficult, except to those skilled in the art through long years of training. * * * But the initial step in live-stock breeding for improvement confronting us to-day is an exceedingly simple one; we do not need to undertake the establishment of new types or breeds, as there are plenty now in existence to choose from which, judiciously chosen, will respond favorably to the conditions to which they are adapted. The first step in the line of live-stock improvement must come from the cessation of the practice of admixing the blood of the various breeds and of using grade and scrub sires.

[a] Compiled from Michigan Sta. Bul. 241.

The plan we have to suggest [for the upgrading of herds] and discuss for the improvement of the common stocks of the country is that known as upgrading, which consists in ingrafting the characteristics of a superior breed upon animals of common or mixed breeding for the purpose of improving them. This improvement is due to the superior quality of the males used and chiefly their prepotency or power of transmitting accurately these qualities to their offspring. This plan differs from crossbreeding in that pure blood is used on the sire's side and females of mixed blood or no blood on the dam's side. Thus we have the prepotency concentrated in the bull and the very opposite in the females, as the more mixed the breeding the less stable are the inherent characteristics of the individual, and therefore the less resistant to improvement.

It would be absolutely impracticable to advise all owners of common cattle to send their stocks to the block and purchase pure-bred foundation stocks; only a few could do this for the following reasons: First, if the great majority now possessed of common stocks were to simultaneously seek to purchase pure-bred foundation stocks, they could not get them; they are not in existence, for only about 1 per cent of the cattle in the United States are possessed of pedigrees. Second, the finances of a great many holders of common stock are not such as to allow them to make extensive purchases of pedigreed animals and replacement is out of the question, as it would require the returns from the sale of three or four common animals to purchase one pedigreed one. Third, it is highly desirable for breeders to grow into any line of pure breeding rather than to buy into it suddenly and take up a work in which experience is necessary.

In general, then, it is necessary for the majority of holders of common stock to make the best use of the animals on hand with a view to improving them. Let us suppose the case of a herd of common or mixed cattle of, say, 18 head and apply a plan of improvement. The first thing for the owner of this herd to do is to decide upon some one line of production, either beef or dairy, and then stand by the resolution. Without this he can not improve his herd, for the animals of mixed breeding are largely the result of frequent change of purpose. Suppose in this case that the owner has decided to go into the dairy business; that being the case, the next thing to do will be to look over the herd of 18 and decide which ones are so possessed of dairy type and characteristics as to warrant their being used in the business. They can be divided into three classes—such as best, medium, and inferior—from a dairy standpoint. Then, in the majority of cases, it will be found to be a decided advantage to send the 6 inferior ones to the block and use the remaining 12 for the foundation herd. Having selected the females to be retained, the next and one of the most important steps is to decide upon the breed to be used in improvement. In this, adaptability of the breed to the conditions and the question of personal preference, are the two important factors; the decision of this question is also an important factor, for a change of mind after the work has begun and the use of other blood is more apt to result in retrogression for a time than improvement. Having decided upon the breed to be used for improvement, suppose it is the Holstein, then purchase the best Holstein bull that the pocketbook will allow. Mate this bull with the 12 selected cows and use him for two seasons, after which his progeny will be old enough to breed. At this point secure another Holstein bull, a better one than the first if possible; follow him with others of the same breed indefinitely. Let it be Holstein bull after Holstein bull, nothing but Holstein bulls. We have cited the Holstein merely for the purpose of this illustration. The same plan must be used no matter what the breed is. * * *

We desire at this point to emphasize the fact that the use of improved methods of breeding alone will not avail. It is absolutely necessary for these to be supplemented by liberal feeding and proper care and management.

The maturity of animals has an important bearing on their value for breeding purposes.

In general, it can scarcely be said of a bull that he has reached full maturity until 4 years of age, though this perfect stage of development is commonly regarded as being attained at a somewhat earlier age among some breeds. It has been a common practice for years among farmers to send the 3 or 4 year old bulls to the block, largely because there is no sale for them as breeders. The general rule among prospective purchasers is to search for nothing but young bulls—yearlings or less—with the idea that they will grow into money for them, if they can dispose of them before maturity. * * *

There are some decided advantages in purchasing mature bulls. One of the greatest of these is found in the fact that the buyer can ascertain something relative to the character of their get. This is most important to the breeder of dairy stock. Another advantage arises from the fact that there is always more or less uncertainty regarding the future development of the bull calf, while this factor is entirely eliminated in the purchase of a mature sire. It is also not unreasonable to conclude that a mature sire will beget more vigorous offspring, especially because the young ones are frequently used to excess. Three and 4 year old bulls can generally be secured at very reasonable prices.

During the past decade or two there has been a growing tendency to breed heifers at an early age. This is particularly true among the dairy breeds. * * *

While it is clearly apparent that immature breeding has reduced the size of many of our dairy cattle, it has not been proven that diminished constitutional vigor has accompanied this loss of size, though many hold to that view. It is rational to assume that in unduly immature breeding some of the physiological laws of nature must be violated, and this can not occur without being followed by some evil results. No fixed age can be given for the breeding of heifers. It should be dependent on the rapidity and character of the development of the individual.

As regards grades versus pure breeds, "high-grade animals may be eventually produced capable of equaling those of the pure breed used in their improvement in so far as meat or milk production are concerned, but at the same time they can never equal them in prepotency nor become possessed of pedigrees, except in rare instances."

In breeding up herds some form of cooperation, in Professor Shaw's opinion, should be established by communities, such as the joint ownership and use of males by several cattle breeders. That such cooperation has not always been successful when attempted is explainable on several grounds, but there is every reason, in his judgment, to believe that it is possible and, rightly managed, will lead to satisfactory results.

VENTILATION OF STABLES.[a]

Some experiment station work along the line of stable ventilation has been summarized in a previous bulletin of this series.[b] Many problems have arisen in connection with the ventilation of stables and have assumed such importance that the necessity for the study

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[a] Compiled from Minnesota Sta. Bul. 98; U. S. Dept. Agr. Yearbook 1904, pp. 216-218.

[b] U. S. Dept. Agr., Farmers' Bul. 190, p. 23.

of the subject from all possible standpoints has been recognized. Important contributions to the subject have recently been made by M. H. Reynolds, of the Minnesota Station. The results obtained by this investigator appear to be at variance with the commonly accepted ideas of ventilation and suggest that new explanations are needed of the observed facts in cases of good and poor ventilation.

One of the main objects of this study was to determine the effect of carbon dioxid upon animals confined in stables. In experiments with human beings in the respiration calorimeter Professor Atwater has shown that man remains apparently in perfect comfort in an atmosphere containing 2.3 per cent of carbon dioxid, or almost 80 times the quantity found in ordinary atmospheric air. The air, however, was kept pure in other respects and the amount of moisture was not unusually high. In the experiments carried out by Doctor Reynolds on cattle the air was saturated with moisture and the amount of carbon dioxid varied, being in some cases as high as 2.67 per cent, as compared with 0.03 per cent in ordinary air. Moreover, the air contained ammonia and other organic materials which may be given off in expired air.

In such an atmosphere, obtained by confining steers in a nearly air-tight box stall, steers were kept for periods varying from two to twenty-eight days. None of the bodily functions were materially disturbed, the only effects observed being a slight increase in the rate of pulse and respiration and a small elevation of temperature. The animals showed good appetite and appeared to be in perfect health and comfort during confinement. The amount of moisture in the atmosphere of the stall was so great that water ran down the sides of the stall and the walls became covered with mold. Nevertheless, animals confined under these circumstances not only appeared to remain healthy and comfortable, but gained at the rate of 1 pound per day. Even the healing process following upon dehorning seemed not to be interfered with by confinement in the moist atmosphere containing more than 80 times the normal amount of carbon dioxid.

Doctor Reynolds concludes from these experiments that the common explanation of the desirability of ventilation in stables must be revised to conform with the results which he has obtained. It is suggested that the air requirements recommended by various investigators for farm animals confined in stables are altogether too high, and, in most cases, impossible of accomplishment. These requirements vary from 14,000 to 32,000 cubic feet per hour, whereas the stall in which steers were confined during the experiments of Doctor Reynolds, contained only 784 cubic feet of air. It is urged that from the standpoint of economy and profit the fundamental

problem in stable ventilation consists in determining the least amount of air change necessary to keep the animals in health and comfort. Further experiments will be carried out to determine the minimum amount of atmospheric change required for this purpose. It is suggested that a well-lighted but poorly ventilated stable is perhaps superior from a sanitary standpoint to one which is poorly lighted and well ventilated.

HOG COTS.[a]

In continuation of a previous article[b] attention is here called to two forms of portable hog houses or hog cots in use at the Wisconsin Station, which are thus described by J. G. Fuller of that station:

The first type of cot used is represented in figure 2 and is constructed in the following manner: The framework, as the cut shows, is made by using 2 by 4's 16 feet long, sawed in the middle, thus making the bottom dimension 8 feet square, each side 8 feet square, the gable ends being thus formed with rafters 8 feet in length. The front sill is laid flatwise to interfere as little as possible with the young pigs going in and out. The frame rests on short pieces of 2 by 4's nailed across each corner, which can be

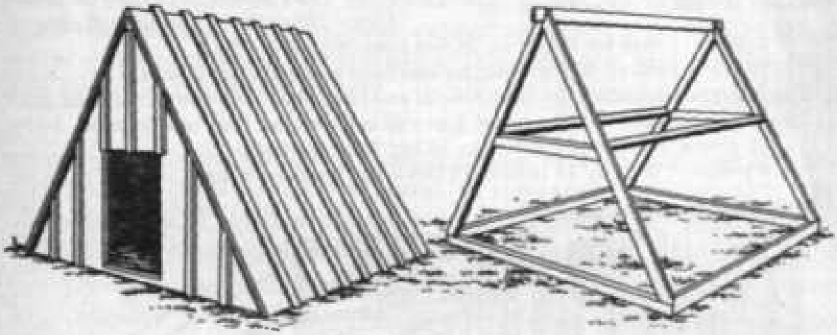

FIG. 2.—Wigwam hog cot used at Wisconsin Station.

replaced when necessary. When a floor is desired it should be constructed on stringers and the frame made to rest thereon. The following lumber will build the house without floor:

13 pieces No. 1, 1 inch by 12 inches, 16 feet long.
6 pieces, 2 inches by 4 inches, 16 feet long.
10 O. G. battens, 16 feet long.

Eight boards, sawed in the middle, make the sides and the remainder, the ends. A small perpendicular slide window is usually made in the rear gable for ventilation. The total cost of material for the house, as shown in the cut, without floor, amounts to practically $11.

Another type of house may be built in two sizes. The larger size, the completed structure shown in figure 3, is 8 feet wide by 10 feet long, 7 feet 2 inches high in front, and 3 feet high in the rear. The smaller house, the frame and completed structure of which are

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[a] Compiled from Wisconsin Sta. Rpt. 1906, p. 42.
[b] U. S. Dept. Agr., Farmers' Bul. 273, p. 11.

shown in figure 4, is 6 feet wide, 8 feet long, 6 feet 2 inches high in front, and 3 feet high in the rear. The construction of these houses is simple, as may be seen from figure 4.

The floor is built first, with 2 by 4's as stringers, and the frame is held on the floor by blocks at each corner. The large-sized house is provided with two doors in front and a temporary movable partition in the middle so that the cot can easily be adjusted to accommodate two lots of swine at the same time. On a level with the glass windows there is also a drop window, preferably hung on hinges, fastened at the top for ventilation and sunlight.

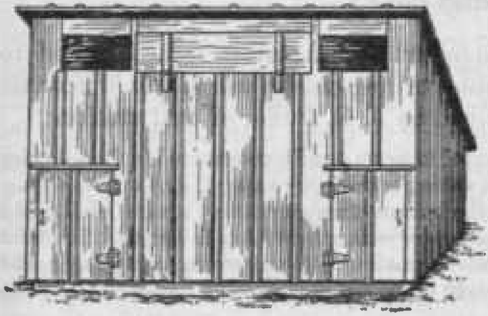

FIG. 3.—Large size hog cot.

The lumber required for the large house, 8 feet wide and 10 feet long, including floor, is as follows:

20 pieces, 2 inches by 4 inches, 10 feet long, for frame and stringers.

2 pieces, 2 inches by 4 inches, 16 feet long, for frame in ends.

20 pieces, 1 inch by 12 inches, 16 feet long, for roof and ends.

5 pieces, 1 inch by 12 inches, 16 feet long (rough), for floor.

15 O. G. battens, 16 feet long, for sealing cracks between boards.

The material, including the door, hinges, and glass, will cost between $16 and $17.

The lumber required for the house 6 feet wide and 8 feet long is as follows:

12 pieces, 2 inches by 4 inches, 16 feet long, for frame.

4 pieces, 1 inch by 12 inches, 16 feet long (rough), for floor

FIG. 4.—Small size hog cot.

13 pieces, 1 inch by 12 inches, 16 feet long, for roof and ends.

10 O. G. battens, 16 feet long, for sealing cracks between boards.

The total cost of material to build the small cot with floor, door, and window complete, amounts to about $12.50. For neatness, economy, durability, and comfort to the animals, this type of cot is excellent. Where it is desirable to keep a number of hogs in one lot the large size is preferable. The small cot will accommodate from three to five mature animals and the large cot from seven to nine.

Although the Wisconsin Station has a large hog house with feed room, scales, etc., the cots have been found a convenient means of enlarging the facilities of the piggery. Of their general advantages Mr. Fuller says:

With the cot system the farmer or breeder can enlarge his accommodations as the size of his herd increases. The mud and vermin which are sure to accumulate around a large hog house can easily be avoided with the small houses and by occasionally moving them to a fresh spot of ground. Where it is necessary to keep only a few hogs together, or where several animals must be provided with separate quarters, the cot becomes an indispensable factor, and can be used to advantage on any farm.

PRESERVING EGGS IN WATER GLASS.[a]

The experiment station literature and other published results of scientific investigations furnish evidence as to the successful use of water-glass solution for preserving eggs, and this literature has been referred to in earlier bulletins[b] of this Department.

As noted in a previous bulletin of this series[b], much of this literature is summarized by R. W. Thatcher, of the Washington Agricultural Experiment Station, and experiments are reported in which water-glass solution, a brine made of lime and salt, and a commercial egg preservative were tested. In these experiments eggs kept in good condition for home use for at least eight months when preserved either with the water-glass solution or with the lime and salt mixture, but considering cost, quality, appearance, flavor, and other characteristics, Professor Thatcher prefers the water-glass solution.

Particular interest attaches to the data recently published by J. Hendrick, of the University of Aberdeen, as he examined a very large number of eggs preserved in water glass under commercial conditions and also made special studies of the quality and composition of eggs thus preserved for long periods. In general, the preserved eggs were found to be of good quality, though they had not been preserved under the best conditions, as they were not placed in the water-glass solution on the day on which they were laid, but were collected in the country and sent into town in large lots and were two or three days old before preservation. As might have been expected, some of these eggs were bad, but the proportion was not large. In one instance out of 384 dozen eggs preserved between April and June and sold between October and December only 5 dozen, or 1.3 per cent, were bad, and the majority of these were broken or cracked eggs.

Usually the eggs which were preserved in water glass, according to Professor Hendrick—

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[a] Compiled from Washington Sta. Bul. 71; Jour. Agr. Sci., 2 (1907), No. 1, p. 100.
[b] U. S. Dept. Agr., Farmers' Buls. 103, 128, and 273.

Have a nice appearance, as the shells are very clean and fresh looking after the water glass is wiped off them. Even those which had been several years in water glass had a fine, fresh appearance. Another advantage of preservation in water glass over certain other methods is that the contents of the egg do not shrink owing to evaporation. The eggs therefore do not rattle when shaken, no matter how old they are. The cost of preservation is very small.

It was found that eggs which had been kept in water glass for a few months could hardly be distinguished in appearance, flavor, and smell, either raw or cooked, from what are called "fresh eggs"—that is, fresh eggs in the commercial sense, which are eggs which should be free from decomposition or taint, but which may be several days old. A really fresh egg, only a few hours laid, is easily distinguished in flavor and appearance when cooked from the "fresh egg" or preserved egg, and is known as a "new-laid" egg. The eggs which had been preserved in water glass for about six months tasted and smelled like well-kept eggs a few days old. As the eggs in question were a few days old when they went into the water glass, they were not appreciably changed to my eye and palate by a few months' stay in water-glass.

As the eggs get older, however, a distinct change is found which can be appreciated both by the eye and palate. Eggs which have been three or four years in water glass are easily recognized. The white becomes pink in color and very liquid. The egg acquires a slightly peculiar taste which * * * suggested soda. At the same time even when four years old the eggs had no unpleasant taste or smell, and the white coagulated in the usual manner in cooking. Though there was a slight characteristic odor when the eggs were cooked, it was not a stale or bad odor and did not suggest sulphureted hydrogen. The changes in the preserved eggs take place very gradually. At one year old they are hardly noticeable; at two years they are distinct, but not so distinct as at three or four years old.

To further test the effects of the preserving solution fresh eggs and eggs which had been kept in water glass one to three years were analyzed and it was found that there was practically no change in their composition even after lengthened immersion in the solution. Practically no silica and little, if any, soda found their way into the eggs. The eggs do not dry up and there is scarcely any change in their ash content, though they contain slightly more soda than fresh eggs. "The alkalinity of the contents of the eggs appeared to increase with the length of time they were in water glass, but the increase was small, and in a complicated substance like egg it was found difficult to measure it accurately." "The slight alteration in the flavor of the egg and in the liquidness of the white may be due to the increase in soda."

To ascertain whether silica was deposited in the egg shell from the water-glass (sodium silicate) solution, samples of shell and membrane from a number of eggs were analyzed and it was found that the amount of silica in eggs preserved for three years amounted to nearly 2.5 per cent as compared with 0.5 per cent in the shells of fresh eggs. "It appears, then, that a slow deposition of silica takes place in the shell of the egg. The percentage of lime in the shells remains practically constant. This deposition of silica in the shells probably blocks up the pores of the shells to some extent and renders them less permeable."

According to Professor Hendrick, the sirup-thick water glass, such as is used after proper dilution for egg preservation, is a sodium silicate. As shown by his analyses it does not contain sufficient soda to neutralize all the acid present, and the solution is strongly alkaline in reaction. A sample of sirup-thick water glass contained 37.91 per cent silica, 16.48 per cent soda, and 0.14 per cent potash, and a solution prepared for preserving eggs, 2.76 per cent silica, 1.20 per cent soda, and 0.01 per cent potash.

On the whole, Professor Hendrick regards the water-glass solution as one of the most popular and widely used preservatives for eggs. "Though this method was introduced only comparatively recently, it has largely superseded older methods, and also appears to have led to much more frequent preservation of eggs on the small scale in households and by small traders. The method is simple and effective. The eggs are obtained when they are plentiful and cheap in spring and preserved for use during the winter months." In such cases it is necessary to keep them for about six months, but they may be kept much longer, for in the experiments referred to above some were left in a solution of water glass as long as four years and were not decayed.

It is assumed that eggs preserved in water glass will be so labeled when offered for sale.

AMERICAN CAMEMBERT CHEESE.[a]

The genuine Camembert cheese is made in France, particularly in the northwestern part, where the industry, originating a little over a century ago in the village of Camembert, in Orne, and shifting soon into Calvados, has reached great importance. This variety of cheese is one of the most highly esteemed of the many soft kinds and has accordingly been imported to a considerable extent into the United States. It is but natural, therefore, that in keeping with the American desire to produce at home the products of all kinds that are of local demand, efforts should have been made to manufacture cheese of the Camembert type in this country.

Until recently these attempts have not been wholly successful. For about three years this Department and the Connecticut Storrs Station, in cooperation, have been investigating thoroughly the making and ripening of Camembert cheese, and in an earlier number of this series[b] has already been noted the substance of a preliminary report on this work, in which it was shown that the principal agents concerned in the ripening process are two species of molds, known technically as *Penicillium camemberti* and *Oidium lactis*.

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[a] Compiled from Connecticut Storrs Sta. Bul. 46.

[b] U. S. Dept. Agr., Farmers' Bul. 225, p. 31.

The manufacture of the Camembert type of cheese at the Connecticut Storrs Station has now been carried on sufficiently long and with such a high degree of success that efforts to establish the enterprise on a commercial basis in this country seem abundantly warranted. To this end Director L. A. Clinton in the introduction to a recent bulletin announces that the Connecticut Storrs Station is now prepared to assist factories and individuals in making this type of cheese, and Mr. Theodore Issajeff in the body of the bulletin describes the plant and equipment necessary and gives directions for making the cheese. While anyone specially interested in making Camembert cheese should of course secure a copy of the bulletin,[a] nevertheless a brief outline of the process of manufacture as given in it and which, it may be mentioned, differs in some respects from that employed in France, may be of some general interest, and with this in view the following points are noted:

The fresh whole milk is warmed to 85° F., and a starter, preferably a pure culture of lactic-acid bacteria, is added. A rather high degree of acidity (0.30 to 0.35 per cent) is allowed to develop, and sufficient rennet (about 8 to 10 cc. per 100 pounds of milk having an acidity of 0.3 per cent) is then added to the milk at the temperature mentioned to secure the desired texture of the curd in one and one-half to two hours. The curd is cut, stirred gently, and allowed to stand for about fifteen minutes, when the bulk of the whey is removed. After being stirred thoroughly the curd is dipped into galvanized-iron forms or hoops, 4 inches in diameter and 5 inches in height and open at both ends. They rest upon a mat made of fine bamboo strips. The cheeses are allowed to drain naturally for four to five hours, when they are inoculated with cultures of the molds mentioned and turned. The next morning they are removed from the forms and salted by rubbing salt on the surface. When the curd is not cut, as is the custom in France, a higher acidity of the milk is necessary (0.40 to 0.45 per cent) and a longer period is allowed for draining. The next day after salting the cheeses are transferred to the first ripening room, which must be nearly saturated with moisture and kept at a temperature of 60 to 62° F. When placed on boards the cheeses are turned daily. During the second week they are wrapped in tin foil or parchment paper and usually put into small round wooden boxes, after which they are transferred to the second curing room, which is kept at a temperature of 56 to 60° and may have a lower percentage of moisture than the first room. Here the cheeses remain for one to two weeks longer before they are in the best condition for consumption.

[a] This bulletin has also been published recently as Bulletin 98 of the Bureau of Animal Industry of this Department.

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